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For the American Railroad Journal and Mechanics' Magazine.

Gentlemen--In the appendix to the last edition of Tredgold on the steam engine and steam navigation, is a paper "on the steamboats of the United States of America, by James Renwick, L. L. D. professor of natural experimental philosophy and chemistry in Columbia college, New York." This account contains so many errors, of fact and opinion, that it appears to us we shall be "doing the state some service," by pointing out a part of them, and cautioning the travelling community, as well as the proprietors of steam vessels, against adopting some of his suggestions, or trusting themselves where such opinions serve as guides in the practical construction and management of the steam engine. He gives a history of the invention, and after stating the extent of country to be benefitted by it, says, "influenced by such considerations, attempts to apply steam to the purposes of navigation were made in the United States, even before Watt succeeded in giving a double action to his engine. The earliest enterprises of this sort, were those of Fitch and Rumsey, which both bear the date of 1783. Both were founded upon the original form of Watt's engine, and both failed, rather from the inherent defects of that instrument, in its power of general application, than from any want of ingenuity or mechanical skill in the projectors themselves." Now the facts in the case are, that Mr. Watt had a double acting engine constructed at Soho in 1782, and took out a patent for it in the same year—and "he had long conceived the idea of this improvement in his mind, and had produced a drawing of it to the House of Commons, in 1774, at the time when he procured the act to prolong his original patent." And with regard to its use by Fitch and Rumsey, neither attempted it, but both thought it entirely too heavy and unmanageable for their purpose; and each set about constructing an engine upon some lighter and simpler plan.

The next material error, is in the account given of the engine used by

Fulton on board his first boat at New York. It is stated, that it was designed by him, and that he made sundry alterations in its form to adapt it to a st amboat. So far is this from being the true account, that in Fulton's last patent (dated Jan. 27, 1811) he says, "I make use of Boulton & Watt's steam engine, or any other steam engine of equal power, my claim to invention not extending to the steam engine but to the proportioning, combining and applying it in such manner, to a boat or vessel of such dimensions as to drive her to a certainty more than four miles an hour in still water." The facts of the case are—the engine was made by Boulton, Watt & Co.—was of a form which they were, at that time, in the habit of making for a variety of purposes—was invented four or five years before, by Mr. Murdock, then a member of that firm—was familiarly known by the name of the "bell crank engine," and was recommended to Fulton by Mr. Watt as the form best suited for his purpose. It is stated, too, that Fulton "had a double provision for uniting the beams to the cranks, and that as it was found most convenient the connecting rod was thereupon extended horizontally to meet the crank." Had he attempted to use perpendicular connecting rods in that case, they could not, with the water wheels he made, have been more than three or four feet in length, and the fly wheel would have divided the air pump through its centre perpendicularly. There *was no provision* made for perpendicular rods, but the bell cranks of the "North River" were cast with large weights on the ends of the horizontal parts opposite to the cylinder, to counterbalance the piston, piston rod, cross head, and connecting rods. The remark, that the engine which Henry Bell built and fixed in the Comet in 1811 (not 1812) on the Clyde, was the model for all the engines used in the British steamers since that time, will require a great deal of illustration before it can be received as correct, by those acquainted with the matter.

We saw the engine of the Comet, at work in a duck manufactory in Greenock in 1829, and have seen many of the engines in use in the British steamers since the Comet's time, and although our's is a somewhat practiced eye, we are really unable to trace the likeness of the copies to the original.

At page 106, it is stated, that in "treatise on the steam engine, which it is believed had some influence in the improvements that have since been made in navigation by steam it was demonstrated, that the power of a given engine might be doubled by loading the safety valve with 57 lbs. per square inch, and cutting off the steam when $\frac{1}{8}$ of the cylinder has been filled, and a saving of $\frac{3}{4}$ of the fuel effected at the same time." If by a "given engine," in this passage, is meant one worked by steam of the force of 4 or 5 pounds per square inch, we have to remark, with due deference to the demonstrator, that practice has, and ever will, and inevitably must prove this and all similar demonstrations, to be drawn from erroneous premises. On this part of the subject it may, perhaps, be well, not to go into an inquiry of what the true theory is, but to state some of the results

of the practice recommended. And this we are able to do readily, from the circumstance, that in drawing up answers to certain interrogatories put by persons engaged in the attempt to get up an Atlantic steam ship, we made the necessary inquiries and calculations to enable us to state the relative consumption of fuel by the British engines, which use low steam, and some of the engines of the fastest running American boats, which are worked by steam approaching pretty nearly to the economical pressure of 57 lbs. per square inch—the particulars will be found in the annexed table.

Name of Vessel.	Number of Engines.	Diameter of Cylinder in inches.	Length of stroke in feet.	Power in horses.	Cords of wood per hour.	Pounds of Liverpool coal equal to the wood.	Rate of consumption pr. hour for the power of one horse	Ratio of consumption of fuel.
Champlain,	2	42	10	332	3 8	4167	12 55	2·18
Rochester,	1	43	10	160	3·0	3290	20 56	3 57
Utica,	1	39	10	130	2 1	2303	17·71	3 08
De Witt Clinton	1	65	10	360	4·0	4386	12·18	2·11
N. America,	2	44	8	266	4·0	4386	16·49	2·86
Frigate Fulton,	2	50½	9	392		4480	11 42	1·98
Great Western,	2	73½	7	40 0		2700	675	1 17
Liverpool,	2	75	7	460		2645	5·75	1·00

In this table the two English engines are set down at the power at which they were rated by the makers—the power of the others was calculated by a rule which gives 61½ per cent more, or the engine of the Great Western if calculated by this rule, would be found to have the power of 646 horses, and that of the Liverpool 670. From these *facts* some estimate may be formed of the value of the *theory* in question.

There are several other minor matters which might be made subjects of remark, but we pass these, in order to enter our unqualified protest against the grossly erroneous and highly mischievous opinion expressed at page 112, where he says, in speaking of the Great Western, "on examining this vessel and comparing her performance with that of American steamboats, it is easy to perceive that her speed might be very materially increased, without making any important change in her engines, and probably with a saving of fuel. It would be necessary to modify the boilers so as to convert a less quantity of water than they now do into steam, but to furnish it of a tension of 20 or 30 lbs. instead of 3½, which they now carry, no when the boiler is of sufficient strength, need any increase of danger be apprehended from using steam of this medium pressure. It is now well established, that the mere pressure of steam is among the least important causes of danger, and that such as are most to be apprehended are as likely to occur in using steam of a single atmosphere, as that of ten or twelve." This whole paragraph is made up of errors; but the last sentence, in which is repeated the absurd and dangerous idea that the *pressure* of steam has little or nothing to do in the bursting of boilers, when such disasters occur, is the most surprising. What else than the pressure of steam ever yet produced an explosion in a steam boiler? What else can find a place in a

steam boiler, while at work, to produce one? The existence of any other cause has not only never been proved, either by reasoning or experiment but the non-existence of other causes which have been supposed to produce explosions, may be inferred from the circumstance, that in every case where the facts could be made out, after an explosion has occurred, the pressure of steam has been found to have been abundantly sufficient to produce the effects observed; and when the same conclusion *must* be arrived at by reasoning from the known laws of caloric and vapor, it is melancholy to find such an opinion promulgated to the world through such a channel, and with the sanction of a respectable name—and it is to be hoped that further reflection, and a more careful examination of the matter, will induce him, at some future day, at least to withdraw his countenance from the practice of using high pressure steam in condensing engines, on board vessels intended for the transportation of passengers—a practice which is far from being economical—which in our own country has already cost many hundreds, if not thousands, of lives, and which, if persisted in, will require the yearly sacrifice of, perhaps, hundreds more.

Respectfully your obedient servant,

JOHN D. WARD.

RAILROADS AND CANALS.

The Camden and Amboy Railroad, its cost and income, compared with the Delaware and Raritan Canal.

The advocates of railways are largely indebted to the directors of the Camden and Amboy railroad, for their full and frank statement of the cost and income of this work, in all its details, as well as of the Delaware and Raritan canal.

The contrast in the receipts, expenses and income, of these two works, (for the same period,) is as great as their comparative utility to the public, and benefit to the stockholders. The *railway*, presents the fact, of gross receipts in six years, (from 1834,) of $4,169,492. Expenses, $1.966,901, —nett income, $2,202,591. This sum is equal to the entire cost of the railway, if we exclude $420,153 charged for steamboats in connection with the line, wharfage $55,600, real estate and right of way $396.769, interest on loans $104,242 during the construction of the work. For the details, we refer to the tables. At page 11 of the report referred to, the directors state the gross receipts in seven years, (altered as above to correspond in time with the canal,) to be $4,637,535.—Nett receipts, $2 383,542, they then observe, "supposing there should be no greater increase for the next seven years, the nett profit, will be in seven years, from January 1, 1840, $1,042,000, from which deducting the interest on the loans to wit, $190,000, will leave the sum of $852,000, or, a dividend of 28 per cent. per annum."

"Passengers increased 11 per cent. per annum. Merchandize 12¾ per

cent. in seven years. The annual nett increase of the profits of the companies, 20 per cent."

Let us now compare the *canal* with the railroad. By the tables of the report, it will be perceived, that the canal has cost the stockholders $2,829,769. "The amount of receipts of the Delaware and Raritan canal, from 1834 to 1839, inclusive, was $306,895

"The expenditures, during six years, 210,344

"Total receipts for dividends, $96,551

This sum is in the ratio of a fraction over one half of one per cent. per annum; of course the canal, it will be perceived, is a dead weight on the railroad.

The railroad, in the language of the report, "has *furnished, on loan to individuals, $117,000 for building boats, for the transportation of coal, through the canal.*" This remark needs no comment. The railroad had to advance capital to the canal, to purchase it business.

It should be taken into consideration, the Delaware and Raritan canal, is of the same dimensions, as the size proposed for the "enlarged Erie canal." The locks, however, are larger, viz 130 feet long by 30 feet wide, adapted to pass barges, steamboats and schooners. The surface of the canal is 70 feet, by 7 feet in depth. The ratio of cost of this *new* canal, with large locks, compared with the present estimates for the enlarged *old* canal, is more than two to one in favor of the Delaware and Raritan canal, whilst the original work, of the Erie canal is destroyed, or abandoned!!! The Delaware and Raritan, unites the Delaware and coal region, with the Raritan, at New Brunswick, a distance of 65½ miles. The railroad is 92½ miles in length, with a double track, ware houses, work and engine houses, &c. &c. complete. The report states, (page 10,) "the tons of merchandize, transported on the railroad in 1833, was 6 043, in 1839, it was 13,520. The passengers yearly transported, prior to the construction of the railroad, 52.000; in 1839 by railroad, the number was 181,479; in 1839 the increase in nett receipts of both was in the ratio of $181,050 for 1833, to $427,286 for 1839."

We find the railroad has commenced the transportation of flour, at 25 cents per barrel, from city to city, along side of one of the best canals in Union, with natural waters to contend with, by the schooners that now navigate the coast, and Delaware river. In one instance within the last month flour was delivered within 40 hours, after the New York merchant deposited his order in the post office; thus proving the position we assume *that celerity and certainty of arrival, with a commercial people will always command a preference*, particularly in the transportation of valuable and perishable commodities. On the Erie canal one-third of the tolls, are derived from merchandize. As a matter of course, competition and the wants of the consumer, will force rival storekeepers, to seek the railroad, on the completion of a line to Buffalo. The line of railway from Albany

to Buffalo, is more than two-thirds completed, the remainder will be finished, even by private enterprize, within two years. Will not the wants of the west and public sentiment, force from the State the monopoly they now enjoy? We think so. Further, will not the early transportation of merchandize on the railway, before the Erie canal is opened, and during the long period it is closed in the winter, reduce its income full 33 to 50 per cent? Of the capacity of a railway *well located*, to effect this, there can be no doubt, with professional and *practical men*, on such a thoroughfare as the line of the Erie canal presents. On it, trains of 250 tons may be drawn at the rate of ten miles per hour, every half hour in the day for 300 days in the year. This would give, as the capacity of the railway 3,600,000 tons. The Erie canal cannot pass to exceed one-fourth of this tonnage, to wit, allowing a boat of 30 tons of goods and produce to pass the locks every ten minutes, (the extent of their capacity,) day and night, for 200 days, the average time it is navigable, which will include Sundays during the season of navigation—excluded in the railroad estimate—and we find the capacity of the canal to be 864,000 tons.

On the Philadelphia and Reading railway, in Pennsylvania, where there is little up tonnage, they calculate to carry a ton of coal from Pottsville to the Delaware river, 98 miles, for 50 cents. From the exhibits they have made of the performance of some of their improved locomotive engines, they have reduced the value of the stock of the Schuylkill canal company (along side of which the railroad is located,) from $360, for $100, to $165. This canal has been one of the most profitable in the United States, yielding dividends of above 20 per cent. per annum to its stockholders. It is clear, that which has been done on one railroad, may be accomplished on another with equal grades, and condition of road. A road from Buffalo to the Hudson can be located, with as favorable grades as that of the Reading railroad; on this road, 423 tons gross, 307 nett, has been drawn 10 miles an hour for 54½ miles, at an expense of $57.

If other instances of the decided advantages of railways over canals for income and general utility are wanted, we would refer to the Boston, Lowell and Nashua railroads. The Boston and Worcester, and Providence railroads, these roads having superceeded in a great measure, the Middlesex and Blackstone canals. The New Haven and Hartford railroad, even before it was completed, so far reduced the value of the stock of the Farmington canal that we understand the city of New Haven taxed themselves, to put it in navigable order the past season, until the railroad to Hartford was completed. *It is presumed that this will be the last of the Farmington canal, except for mill races on its line.*

We cannot take leave of this subject without presenting some official facts, from three of the six railways that have been completed in Massachusetts. We find the receipts on the Boston and Lowell, and Nashua, the Boston and Providence, the Boston and Worcester, for 1839 to be

From passengers, 492,770
From freight, 294,044
111¼ miles cost $5,189,731, equal $46,545 per mile, produced $786,814
eq al to 15 p r cent. gross, or 11 per cent. nett, this too, where the turnpike and common roads leading into Boston, are not exceeded by any roads in any State, in the Union.

The following table, presents the increase and comparison for the years 1837, 1838, and 1839, of the three principal roads first constructed in Massachusetts. These roads were among our first experiments, they could *now* be built for half what they cost, exclusive of land damages.

Name.	Year.	Cost per mile.	Income from passengers.	Income from freight.	Total receipts.	Total expenses	Nett profits.
Boston and Lowell	1837	62,465	11761	63137	18077	78508	02162
	1838		109083	82697	191780	75597	116183
	1839		135037	106131	241168	92151	149069
Boston & Providence	1837	43,430	19346	5741	250882	156238	94644
	1838		196974	68140	265114	120044	145070
	1839		234237	79670	313907	93562	220345
Boston and Worcester	1837	40,433	123331	86716	210047	94762	115285
	1838		112032	100292	212324	85572	126752
	1839		122496	109311	231807	126384	105413

In the event of a war with Great Britain, who can calculate the saving to the public treasury, in the transportation of munitions of war, and men to Maine, and to our Canadian frontier.

If such flattering results and advantages are presented at the commencement of our system of railroads, what will they not yield, with the increase of our population. Experience and mechanical ingenuity has taught us to reduce their cost, their management, and to improve on the engine. Ten years has already produced results almost incredible, a few years back $2500 was offered to construct an engine capable of drawing 20 tons on a *level* railroad ten miles per hour.

The prejudice against railroads, which has existed, and continues to exist, must give way "*to the better improvement of the age.*" The doctrine of Bridley "that rivers were made to feed canals," has been carried to an extravagant extent in its application. This obsolete doctrine we trust will no longer be listened to, by intelligent legislators, in this or any State.

The period, we trust has arrived, when the *canal mania*, which has so long governed us must give way to more *sane* counsels. The people are too well informed to submit to taxation, and a forty million debt, for the construction of a work, that cannot be used its entire length, to exceed six and a half to seven months in the year, in fact the enlargement of the Erie canal to the size of 7 feet by 70, we repeat is behind the intelligence of the age; and if persisted in, history *will cover with disgrace all those connected with it.*

The time has come to republish the following extract from "*An appeal*

made to the representatives of the people in relation to the proposed enlargement of the Erie canal," in 1836, which few would then listen to.

At page 14, the writer says, "We cannot avoid expressing our belief, that if the enlargement is persisted in, as contemplated, a reaction will sooner or later ensue, highly prejudicial to those who may have assumed the responsibility of the improvement. The voice of our legislature may not be echoed by another. There is no guarantee that the tones of acquiescence, or approval, but lately heard on this subject, will find an agreeable response from other lips. The spirit of inquiry will be awakened.—The merits and demerits of this great and momentous subject, will be investigated, and unless we mistake the intelligence and spirit of the age, it must result in consequences, *which all will wish had been avoided.*" How true to the letter.

In presenting the foregoing facts, we aim at the public weal. We desire to substitute railways in aid of canals, particularly in latitude 43. Our object is to elicit discussion, and to assist in dispelling errors produced by official reports, in comparing canals with railways. These reports have in part been the means to entail on us the Genessee valley and Black river canals, as "*gentlemen paupers,*" to the tune of $400,000 per annum, and this too, where a vote of the people would now prefer railroads, the R. R. would pay an interest on their cost, and be in use the entire year. The reports alluded to, issued with the sanction of Congress, and our own Canal Board, 1835, carried the above named canals, the Chenango canal, and the greatest of all legislative follies, "*the enlargement.*" A work that no party, or Engineers will now own or be responsible for its completion in twelve years for $35,000,000.

The enlargement of the lateral canals must follow the Erie. Under this view we cannot better close these remarks than by quoting from No. 4, of a series of able essays published in the Railroad Journal, with the signature of "FULTON." The writer says, "*Of all the visonary projects of which the State of New York has been drawn by the influence of unwise counsels, the enlargement of the Erie canal, is the most visonary, and the sooner she makes haste to retrace her steps, the better. The State is already in for about $60,000,000, for canals alone, without even a reasonable prospect of being able without a resort to taxation to pay the interest on that amount. Is it not time to pause in this course of extravagance?*".

We answer aye—let the present legislature examine into the merits of well constructed railways, and their capacity to carry all classes of produce, and we venture nothing in stating our opinion, that the Erie canal, with its original size of 4 feet by 40, (it is now filled up with bars and deposits to 3 feet water,) with double locks to Montezuma, will be adequate for the *trade* on it, for the next half century; from the fact, that the packets and *packet line boats*, will be discontinued so soon as the line of railroad is completed to Buffalo. This will take place as soon as permission is giv-

en to the emigrant to, and from the west, to pass through this State with his baggage and effects on a railroad, even with the onerous tax to the State treasury, of the same tolls persons pay to the canal. The reason is obvious, he will readily pay this tribute to the State to save 5 or 6 days in time, in transporting his family from Albany to Buffalo. Further, on clearing out the canal to full 4 feet it can be demonstrated, that the well constructed lake boat and scow, (to which the Erie canal should be limited,) will double the present tonnage. For the last five years it has fallen off 140,000 tons, in lumber, and will decrease yearly, on the completion of the railways to lake Erie. This must occur, as celerity and certainty of arrival, are two of the main elements of commerce, for which the public will pay, as we see in the instances quoted.

J. E. B.

For the American Railroad Journal and Mechanics' Magazine.

CUMBERLAND ROAD.

Of all the works of internal improvement ever undertaken by authority of the general government, under the head of roads and canals, there is none that reflects so much credit upon the nation as the great Cumberland road, connecting Baltimore and St. Louis.

In the direction of Wheeling on the Ohio river, this road has been completed and in use for several years past; that now completed in Ohio to Springfield, has been finished more recently, and the remainder of the distance to St Louis, through the States of Ohio, Indiana, and Illinois, has been in progress, with the exception of that portion between Vandalia and St. Louis, which has only been surveyed. It is contemplated to continue it ultimately to Jefferson city, in Missouri, the surveys having extended that far.

Situated, as are the Alleghanies, between Baltimore and Wheeling, there has been a great variety of difficulties to contend with in the location and construction of a safe and permanent road over this barrier—in fact, the whole distance between the two places is little else than a succession of hills and valleys, scattered in admirable confusion on your front, flank, and rear. Great, however, as have been the obstructions, energy and perseverance have in a measure levelled them, and no reasonable expense has been spared to perfect it in all its details; and as far as completed we have by this road better facility for the transportation of passengers and the mails than on any other route where post coaches are used, so rapid is the transit of the latter, and to insure its expedition, but three passengers are allowed to be conveyed by the mail between Baltimore and Cincinnati.

The topography of the country traversed by this road on the west of the Ohio river is much broken, till near Columbus, when it changes character with its rear, and becomes more uniform and frequently level. In Indiana it partakes more of the latter character, but is undulating in approaching the water courses, and traverses much of a timbered section, denominated

beech flats. A great portion of Ohio and Indiana on the line of the road is heavily timbered. On the west of the Wabash river, for a distance of twenty-five miles in Illinois, it is undulating and timbered, but mostly oak openings. After this the great praries are met with, and they have the predominance the remainder of the distance to St. Louis.

With the maximum inclination over the mountains, I am not conversant, nor of the exact width of roadway proper, but presume the latter is the same as that adopted in the States in advance, viz., thirty feet. The Macadamizing material is of an excellent quality, and preserves a uniform and hard surface; and the roadway proper on all inclinations of any magnitude is well protected from washing by a series of gentle ridges crossing the road at intervals of two hundred feet, obliquely, serving the purpose of carrying off the water, and at the same time to check the force of gravity in descending.

From Springfield, in Ohio, to Vandalia, Illinois, a variety of work in detached sections of the road has been done, amounting, however, to much less than one half of the aggregate amount necessary. In Indiana, a few miles of the road at Richmond, Indianapolis, and Terre Haute, have been macadamized, but in Illinois, this kind of work has not been began.

The width of this road has been fixed at eighty feet, and the clearing and grubbing carefully extended between the extreme limits of the cuts, ditches, and embankments. The roadway proper, has a width of thirty feet when finished, with a berm of about two feet, except in heavy excavations, and embankments. In the cuts, the depth of the ditches are one foot and a half and their width at bottom, two feet, and those elsewhere, two feet in depth, and eight feet at bottom; and where the slopes of the ditches are such that danger may be apprehended from washing, they are paved. The slopes of the embankments and cuts are two feet horizontal, to one foot of vertical height, and are sodded, or sown in blue grass seed, and protected till the grass is well set. No inclination exceeds one in twenty-five, in Illinois, and as far as I am informed, it will apply to Indiana, and most of the road in Ohio.

When any part of the road is finished, the travel is admitted thereon, and regulated by placing logs or other obstructions, alternately on each side of the road, from the centre to the sides, at intervals of one hundred and twenty feet. These barriers are moved westward twenty feet each day for twelve days, and so on alternately changing the travel on the road daily.

Rock of a lime stone description, and of a quality suitable for the purposes of masonry is generally found in great abundance convenient to the road, but in some locations the haulage is considerable. The rock, when quarried is cut or hammer dressed, and subjected to a rigid inspection before being laid in the walls of a structure; there are, however, a few bridges, the masonry of which is rock work without margin, and the timber generally used in the frame of the latter, is of white or bur oak. There are some very fine specimens of bridge architecture on this road at Colum-

bus, Ohio, and at Richmond and Indianapolis, in Indiana. The one contemplated at Terra Haute, across the Wabash river, will be an ornament to the place, when constructed. The former are completed, but the latter has only been so far begun as to contract for the delivery of the necessary rock for the abutments and piers. The quarry from which this is procured is in Illinois, near the State line, and on the south of the road. A temporary railway of wooden rails, has been laid from the quarry to the Wabash river, a distance of seven miles, and from the place of delivery on the river, which is below Terra Haute. Scows, towed by a small government steamer, are used to deliver the rock at the latter place.

In macadamizing the road, the centre, which was left about one foot above the sides at the time of finishing the grade, is reduced to a suitable convexity, and the broken stone laid on in layers, to an aggregate depth of nine or ten inches, and extended ten feet on each side of the centre.

The yearly appropriations of Congress for the construction of this road, have heretofore been made with commendable promptness, and in the spirit of the compact existing between the general government and the respective States concerned, but in some few instances the appropriations have failed, as was the case the last year, but it is confidently hoped, that Congress will not allow a repetition of that failure for the present year..

MACADAM.

For the American Railroad Journal and Mechanics' Magazine.

RAILWAY CONSTANTS, BY DR. LARDNER.

Permit me to call your attention to the article in your Journal of Feb. 1, 1840, in which Dr. Lardner's paper on Railway Constants, is made the subject of severe, and as it appears to me, unjust criticism. The writer of the article is obviously in error, in the view which he takes of the action of the several forces operating upon bodies when descending inclined planes.

So long as the force of gravity continues to act and the body encounters no resistance, its motion will be uniformly accelerated. If the force of gravity is suddenly suspended, the body will move on without a *uniform* instead of an *accelerated* motion, the velocity being that last acquired at the moment of the withdrawal of the accelerating force. If the accelerating force, or force of gravity, instead of being withdrawn, is *counteracted* by forces which are *equivalent* to it, the result is the same, viz. an *uniform* motion.

Should it be discovered therefore that the velocity of a train of railway cars in descending a plane of a given inclination, becomes uniform, the inference is just that the *entire* force of gravity upon the plane, is at the velocity attained, *counteracted;* or in other words, the combined forces of the resistances from friction and the atmosphere are then equal to it, and both bear the same relation to the weight of the train as the height of the plane to its length.

To say therefore that this force (gravity) "generates and keeps up" the

velocity acquired, and "overcomes the friction and resistance of the atmosphere," and *hence* that the height of the plane is the measure of and resolvable into these *three* forces is not correct in point of fact.

The total accelerating effect of gravity upon the train up to the moment of acquiring the uniform velocity is not *counteracted* but is *preserved* in the *uniform motion* of the train, which has no limit to its continuance, but the length of the plane, or the interposition of a resistance additional to that by which the uniformity of the motion was produced.

The writer of the article has evidently confounded what may be termed the *quiescent* force of gravity as indicated simply by the ratio of the height of the plane to its length, with the *momentum* or force expended in producing the uniform motion; which latter depends upon the distance passed over in acquiring that motion and is not impaired by the subsequent resistances which operate *solely* to *neutralize* the *continued* effect of gravity and are correctly expressed by the ratio above given of the height of the plane to its length.

Since the remarks of the writer are based upon premises which are untenable and unsound it is almost needless to say that in his course of reasoning there are many inconsistencies and that the conclusions therefrom are fallacious.

Without expressing an opinion as to the degree of confidence proper to be placed in the experiments of Dr. Lardner and Mr. Wood, it is believed that no exceptions can reasonably be taken to the position assumed by them, that when the motion of a train upon an inclined plane is uniform, there being no other force operating but gravity and the resistance of friction and the atmosphere, these forces are in equilibrio, the two latter as well as the former bearing the same relation to the weight of the train as the height of the plane to its length.

Mr. Brunel who is particularly distinguished for his science and sagacity would not have failed to discover and to point out the "grand error of Dr. Lardner," had such an error in fact existed.

As the paper of Dr. Lardner is one of interest, containing statements and inferences, which *if correct*, are of importance to the profession, I would suggest its publication in your Journal. It may be found in the Civil Engineer and Architects Journal for the month of October 1839.

Yours very respectfully,

L. WILLIAMS.

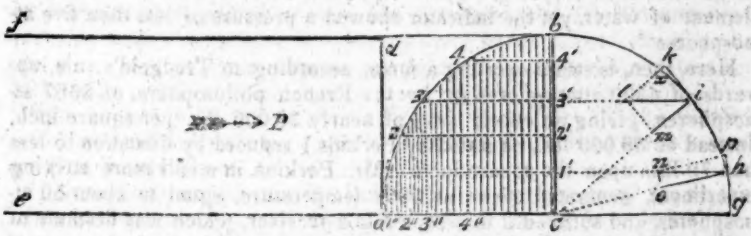
It will be seen in our last number, that the writer of the article in question, has discovered and corrected the error above mentioned.—*Eds. of R. J.*

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

Mr. Roebling's new "Theory of the crank" appears to be founded on a mode of representing a given force by a surface, instead of, as usual, by a line. Thus he says, "when the power has moved from *a* to *c*, the

amount of power or momentum, actually applied, is represented by the square $a\ c\ b\ d = R^2$." If the same reasoning be applied to any of the abscissas with its corresponding ordinate, we shall have a similar result; for "when the power has moved from," a to 3″ the "amount of power actually applied is represented by" the parallellogram having for two of its sides a 3″ and 3″ 3, and, when the power has moved from a to c, the ordinate and abscissas are equal and their product is the square of either = R^2.



The investigation will be rendered easy by assuming a line instead of a surface to represent the power. Let the power expended in moving from a to c be represented by the line $ac = 1$. When the power has moved from a to 1″ the crank pin has moved from a to 1 and supposing this portion of the arc = 10° (as a first approximation) the distance a 1″ will be ·0151922 and the length of the arc a 1 will be ·174533, both being expressed in terms of $ac = 1$. The crank pin has therefore moved 11·48 times farther than the power, and, if the force with which it has moved through this distance be in the inverse ratio of the length of the arc a 1 to the line a 1″, the dynamical effects will be equal. Now, as Mr. R. says the leverge of the crank at 1 must be $= 1'c = 11''$ and, assuming the average power to be $\frac{1}{2}$ of 11″ we should have the value of the useful effect = the length of the arc $a1 \times \frac{1}{2}$ the line 11″ = ·174533 × ·0868241 = ·0151536, while the actual expenditure of power by the prime mover is = $a1''$ = ·0151922, the difference being only ·0000386. The smaller the portion of the circumference taken, the less will be the difference; but, as this mere approximation shows a difference too small to be felt in practice, it is unnecessary to go any farther.

The direction of the force in practice is not however parallel to ac, but is continually varying and here will necessarily be some loss to obviate which the connecting rods are made as long as possible, this, however, as well as the contrary varying motion from a to c required to produce a uniform motion throughout the arc a 1 2 3 4 b are practical questions which have no connection with the case under consideration, where the power is supposed always to act in parallel lines and where the general dynamical effect only is considered.

W. R. C.

New York, March 24, 1840.

OF THE APPLICATION OF STEAM AS A MOVING POWER, CONSIDERED ESPECIALLY WITH REFERENCE TO THE ECONOMY OF ATMOSPHERIC AND HIGH PRESSURE STEAM. BY GEORGE HOLWORTHY PALMER, M. INST. C. E.

(Continued from page 187.)

Mr Perkins states in the fourth volume of the Register of the Arts and Sciences, when treating on the subject of high pressure boilers—"In some recent experiments I have heated steam to a temperature that would have given all the power that the highest steam is capable of exerting, which would have been 56,000 lbs. upon the square inch, if it had its full complement of water, yet the indicator showed a pressure of less than five atmospheres."

Here, then, is steam exerting a force, according to Tredgold's rule, upwards of 4500 atmospheres, or, by the French philosophers, of 2567 atmospheres, giving an elastic force of nearly 38,000 lbs. per square inch, (instead of 56,000 lbs., as stated by Perkins,) reduced by dilatation to less than 70 lbs. upon the square inch. Mr. Perkins, in a still more striking experiment, generated steam at 500° temperature, equal to about 50 atmospheres, and suffered it to escape into a receiver, which was destitute of both water and steam, heated to about 1200°, which steam, for want of water to give it its necessary density, the indicator showed a pressure of about five atmospheres.

Proof beyond this, (particularly as it is in strict accordance with the laws of nature,) would be almost superfluous, for here we have steam of 50 atmospheres, (should have been 46 atmospheres,) although permitted to expand in a receiver little short of red heat, indicated no more than five atmospheres elasticity; if, therefore, the second dose of sensible caloric taken up by the expanded steam had been as effective as the sensible caloric become latent by dilatation, the elasticity of the steam, instead of registering only five atmospheres should have denoted upwards of 3000 atmospheres elasticity.

The fourth theorem, viz., that high pressure steam of, say, 10 atmospheres elasticity, does not contain 10 measures of atmospheric steam, or what is the same thing, ten times as much water as is contained in an equal volume of atmospheric steam, is in my mind so fully established by what has been advanced in support of the previous propositions, that it would be wasting the time of this Institution to adduce further proof. In fact, all the questions are so intimately connected, and depend so much the one upon the other, that it is difficult to discuss [or ˈprove the one without demonstrating the other.

Who, may I be permitted to ask, can believe the phenomena of nature, and at the same time advocate the principle that high pressure steam worked expansively, is attended with a saving of fuel, as compared with the effect brought out by employing atmospheric steam as a first mover? In my mind, to apply high pressure steam expansively as a motive power, even when kept at its generating temperature, amounts to nothing more or less than gaining an advantage in order to abandon that advantage, and to produce a less effect than can be produced by going a less roundabout or circuitous way to work, and thereby subjected to all the evils consequent upon substituting complexity for simplicity, in addition to the extra capital invested, extra fuel expended, and extra labor and wear and tear of apparatus.

I had hoped the public hints that Mr. Woolf has received would have induced that gentleman, ere this, to correct the erroneous table he many

years since promulgated relating to working high pressure steam expansively; the publishing of which has been productive of great evil to practical science; for in addition to Mr. Woolf' testimony of the validity of the theory then launched, may be adduced all those lecturers and authors who in their oral and written opinions do not throw out the least hint, much less attempt to prove the fallacy of the principle, viz., that steam of a given number of pounds elastic force, over and above the atmospheric pressure, when expanded as many times as it exceeds in pounds per square inch the atmospheric pressure, would, when so expanded, if maintained at the temperature at which it was generated, be equal in its elastic force to unexpanded atmospheric steam. The late Mr. Tredgold and Dr. Lardner, (and probably others who have not met my eye,) have exposed the fallacy of this table; and as their remarks are public property, it will redound very little to the credit of those lecturers and authors when made acquainted with the refutation, if they do not follow up the subject till the principle is exploded, as every theory ought to be that is contradicted by, or in opposition to nature's laws.

I exceedingly regret that Dr. Robinson, who was aware of the doctrine of latent heat as expounded by Black, should, (in his formula laid down under the article "Steam," in the Encyclopædia Britannica,) confound steam and permanent gases, by assigning a law to the former (steam) that was only applicable to atmospheric and other uncondensable gaseous matter; in doing which, that celebrated man lost sight of the fact that the sensible caloric becoming latent by dilatation could not be compensated for by saturating the expanded steam with the same number of degrees of sensible caloric. For instance, heat a given volume of atmospheric steam from 212° to 696°, when its elasticity will be about doubled, that is, it will maintain a pressure of about 15 lbs. over and above the atmospheric pressure; whereas steam generated at 696° temperature would give an elastic force equal to about 112 atmospheres, or multiplied into 14, equal 1568 lbs. pressure upon the square inch, by Tredgold's rule; thus then we are enabled to see and judge of the value between a given number of degrees of sensible caloric being applied to generate steam, containing its due proportion of water, and when the same amount of caloric is applied to expanded steam, necessarily deficient of that proportion of water due to its volume, and which alone can give the steam an equally effective elastic form, however, afterwards saturated with caloric.

It was a saying with our late worthy President, "Give me facts, for one fact is worth a thousand arguments." If the statements given to the public by the Cornish engineers, whose sincerity I cannot doubt, are correct, I dare not trust myself to call nature to account for the undue favoritism she confers upon our Cornish friends, by enabling them to perform results in Cornwall, that the London, Manchester and Birmingham engineers cannot approach; and I shall perhaps be excused from expressing my surprise that the question has not been long ago set at rest, by some one erecting in London or elsewhere an engine capable of raising 70,000,000 lbs.—I will not ask so great a favor as 120,000,000 lbs.—of water, one foot high, by the consumption of one bushel of coal. Let this be done, and I shall be the first to hail the result as one of the greatest achievements of man over matter, and give the Cornish engineers that meed of praise they would so richly deserve, whether for the benefits conferred upon science, or upon the manufactures and commerce at large.

Before I conclude this paper, it may be necessary to refer to the fact, that an engine working the steam full power the whole stroke of the piston is

found to consume rather more than double the quantity of fuel such engine expends, when working her steam expansively, by cutting the supply off from the cylinder before the piston has completed its stroke; whereas the increase of the engine's power (say a double Watt engine, of 10 horse power) is only in the proportion of 10 to 14·6 horses. Now this difference refers to steam generated at an elasticity balancing a column of mercury 35 inches high, consequently little loss of power takes place on expanding such steam, by cutting it off when the piston has made about four-fifths of its stroke, provided it be maintained when so expanded at the same temperature as the steam in the boiler, because the steam's density is only diminished one-fifth; therefore, the loss of sensible caloric becoming latent by dilatation, and the loss of power consequent thereon, are very nearly compensated for, by the expansive or increased elasticity the expanded steam undergoes, by absorbing the second dose of sensible caloric; excepting, of course, the loss of nearly $3\frac{1}{2}$ lbs. per square inch due to the deficiency of water in steam expanded to one-fifth its volume. This is not the case with steam generated at 40 lbs. or more upon the square inch when suffered to expand as in the Cornish engines, for the loss of elasticity or power is in a greater ratio than that of steam balancing a column of mercury 35 inches high, inasmuch as steam of greater elasticity contains a less proportion of water than steam of less elasticity, for the reasons previously explained.

The causes that may lead to the loss of fuel by working an engine at full stroke, instead of expansively, I will just refer to. One or more of these combined, (independently of the aforesaid cause, viz., sensible caloric becoming latent by dilatation) is quite sufficient to account for the extra quantity or loss of fuel expended, by letting the steam act full pressure during the full ascent or descent of the piston.

1st. The engine not having a constant maximum duty to perform.

2nd. A portion of the steam escaping between the piston and the cylinder.

3rd. The valves, slides, or cocks, may not be perfectly steam tight, in which case a loss of steam power or fuel is the consequence, and that in a greater ratio as the steam's density is increased.

4th. A portion of atmospheric air may enter the condenser independent of that held in solution by the water, and thus throw an additional duty upon the air pump and engine.

5th. Steam blowing from the safety valve when the engine's duty falls below its maximum.

Any of the aforesaid, in addition to bad stoking, by letting undecomposed atmospheric air carry off a portion of the caloric generated, or by a loss of fuel, arising from imperfect combustion of the fuel passing off in the shape of dense smoke at the chimney shaft, contribute more or less to destroy the economy of the engine.

I presume that none will be found to deny, that a constant given power multiplied into a given speed of the piston, will bring out a greater result than the same power multiplied into a lesser speed, which is the precise position in which unexpanded and expanded steam are to each other; in addition to which, must be added to the latter process, (the one universally adopted,) the loss consequent upon sensible caloric becoming latent by dilatation. The very fact of being able to work steam expansively, not only demonstrates that the engine is not working up to, or performing its maximum effective duty, but that the engine is contending with a fluctuating power or resistance, as is the case with the Cornish pumping engines, and are consequently working under disadvantageous circumstances.

If the evidence herein adduced tends to establish the fact that the at-

mospheric steam produced by one bnshel of coal, applied as a motive power, without being permitted to dilate even in the absence of all friction, and when the barometrical pressure of the atmosphere is greater than what is generally witnessed, (namely, a column of water 35 feet in altitude,) can raise no more than 44,467,500 lbs. one foot high, how is it possible for high pressure steam when worked expansively to perform more duty than atmospheric steam, or be a more economical process, if we are assured that sensible caloric becomes latent by dilatation?—that the sum of the sensible and latent heats in steam of every elasticity is a constant unvarying quantity—that all matter, by undergoing change of density, either takes up or gives out caloric—that equal quantities of caloric convert equal quantities of water into steam, whether the steam generated be atmospheric or high pressure—that atmospheric steam expands no more than 1694 times the bulk of water from which it was generated when maintained at the generating temperature—that steam of double, treble, or more elasticities, does not contain double, treble, or the like quantities of water that is contained in an equal volume of atmospheric steam—and finally, that expanded steam, when saturated with the same amount of sensible caloric that it lost, (or that becomes latent by dilatation,) will never acquire the elastic force it possessed previous to dilatation. Admit all the foregoing phenomena to be in strict conformity with the laws of nature, and I cannot conceive it possible, but the conviction must follow, that working high pressure steam expansively is less economical than working atmospheric steam full pressure. Upon what principle, then, permit me to ask, can the Cornish engines perform so much more duty than all the other engines?—Strong, indeed, should be the evidence that ought to out-weigh or cancel the foregoing laws of nature, and induce this Institution to sanction statements of duty more than double that of the best Watt engine, and still more, surpassing the limits nature has assigned steam to perform, (under circumstances over which man has no control, the atmospheric pressure,) unless, as before premised, the Cornish engineers can convert with 7 lbs. of coal, more than 62½ lbs. of water from 40° F. to atmospheric steam; and unless highly elastic steam can be applied as a first mover without converting sensible into latent caloric.—*Trans. Inst. C. E.*

For the American Railroad Journal and Mechanics' Magazine.

HOGSHEAD CAR.

Gentlemen—I was attracted while travelling yesterday on the Charleston and Hamburg railroad, by a huge, or mamoth hogshead, flying with the speed of a locomotive, in company with the other freight cars, along the railway. Though 21 feet long. and 8 feet diameter at the bilge, and capable of transporting 29 bales of cotton, it had been facetiously called by the agents on the road, the "fifteen gallon keg." I conceived, at first, that it was a water cask, for the supply of the engine, in this season of drought, but soon discovered my mistake, in perceiving it freighted with 15,000 lbs. of coffee, and sundry boxes of dry goods. On examination, I found it was an experiment, suggested by Col. Gadsden, to test the superiority of the hogshead form for railroad cars; and that it had been so successful, that president Tupper contemplated substituting them for those of other construction, which had hitherto been in use.

You will readily estimate the improvement, when you are informed, that they are simpler, and cheaper of construction, much lighter in weight, re-

quiring no protection from fire, as, from their rotundity, the cinders from the locomotive are shed as fast as they fall, that the pressure of lateral and opposing winds, is less, and that, most of all, they suffer but inconsiderably from the jarring effects of locomotion, and will admit of wheels of larger dimensions than those now in use. They will not only be more durable than the square frame cars, and thus diminish expense; but will more certainly resist the shock of collision or accident. Indeed, it is believed, that if properly constructed of good materials, the hogshead car may be thrown from the bed of the carriage on which it rests, freighted, and yet receive no injury.

You will readily perceive the great superiority of the hogshead car, and the above is communicated through your useful Journal, for the information of other companies who may be disposed to adopt or test it. Mr. Tupper has now under construction several of dimensions capable of transporting from 40 to 45 bales of cotton, and will soon experiment with one for passengers, which may be ornamented with a dome, or sky light at the bung. Every thing which will diminish expense, from the injury resulting from the jaring and rapid motion on a railroad, is considered an important desideratum gained, and little doubt is entertained that all who use the hogshead car, will acknowledge the great superiority in this respect.

A. B.

FOURTH ANNUAL REPORT OF THE CHARLESTOWN BRANCH RAILROAD COMPANY.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The directors of the Charlestown Branch Railroad Company do hereby respectfully make their fourth annual report of their acts and doings, receipts and expenditures, under their act of incorporation:

In the last report it was stated, that the road was completed from the junction of the Boston and Lowell railroad to Gray's wharf in Charlestown; since which a second track has been completed for a distance of about fourteen hundred feet from the easterly termination, and the road opened for transportation of merchandise.

The act passed at the last session of the Legislature, in relation to this company, has been accepted.

A contract has been made between this company and the Nashua and Lowell railroad company, for the use of this road, (a copy of which is herewith submitted,) and the said Nashua and Lowell railroad company commenced transporting merchandise under said contract of the first of June last.

By a statement of the treasurer, made up to the 1st inst. it appears that the receipts of the company the past year have been,—

From assessments,	$50,075 00

And the expenses for the past year, to same date, have been,—

For miscellaneous expenses,	$3,915 13
" damages for land taken,	19,730 90
" construction of road,	13,417 61
" expenses of road,	242 50
Total,	$37,306 14

In compliance with the sixth section of "an Act concerning railroad corporations," passed April 19th, 1837, the directors further report:

The total amount of capital paid in, is	$100,200 00

The total amount expended is as follows, viz:

For construction of road,	$60,914 10
" land, and damages for land taken,	23,356 57
" miscellaneous expenses,	6,515 16
" expenses of road,	242 50
Total,	$91,028 33

The length of the road from the junction with the Boston and Lowell railroad to Grey's wharf, viz:

Embankment at westerly end of road, 15 feet wide on top,	1300 feet.
Bridge across the bay to Prison Point, 25 feet wide,	2460 "
From Prison Point to Gray's wharf, principally over land made on flats, (25 feet in width,)	3140 "
Total,	6900

The number of planes on the road are four—two are level, one has an inclination of $10\frac{43}{100}$ feet in a mile, and the other has an inclination of $14\frac{11}{100}$ feet in a mile.

The greatest curvature on the road is on a radius of 550 feet.

The rails are of the T pattern, and are secured to cedar sleepers, laid on a longitudinal sill of pine, 4 by 9 inches, the said sill resting on a bed of beach gravel.

All which is respectfully submitted,

Charles Thompson, T. C. Smith, Abijah Goodridge, Eben'r. Barker, *Directors.*

FOURTH ANNUAL REPORT OF THE EASTERN RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The Directors of the Eastern Railroad Company, respectfully make their fourth annual report.

During the past year the passenger trains have been run on the road between Salem and Boston, and with very few exceptions at the regular times and merchandise trains have been run daily, with few omissions since the first of February.

The construction of the road, bridges, etc., beyond the depot in Salem, has been steadily pursued, including some important structures, particularly the Tunnel under Court street, in Salem, of rising six hundred and fifty feet in length, with a walled excavation at each end of nearly six hundred and fifty feet in length in the whole, and a pile bridge of about eighteen hundred feet in length across the North River between Beverly and Salem about one thousand of which is of oak piling.

These structures have been wholly built and completed during the past season. The road, bed and bridges, including a bridge over Ipswich river has been completed, and the superstructure or railway laid as far as the depot, near the centre of the town of Ipswich, and on the 18th of December last, the road was opened for public traval, to that depot, a distance of about 25 miles from Boston.

An act was passed at the last session of the Legislature, authorising the construction by the company of a branch railroad, "from some conventien point in the city of Salem, to the town of Marblehead." In pursuance of this act, a branch railroad has been constructed and completed during the past season, and was opened for public travel on the 10th of December last.

This branch is nearly three miles in length, and in its course passes over Forest river, by pile bridge of about 350 feet in length.

The grading of the road beyond Ipswich, has been vigorously prosecuted during the past season, and it is expected that the part between Ipswich and Newburyport will be ready for the rails soon after the frost is out of the ground the ensuing spring, and that the iron, sleepers, sills, &c., for the superstructure, will be ready in season to enable the company to open the road for travel before summer.

Satisfactory arrangements have been made for the erection upon the site of the Newburyport bridge, of a structure which shall conveniently accommodate the carriage and foot travel passing the Merrimack at that place, and at the same time furnish a firm and durable bridge for the passage of the railroad. This structure is contracted for, and the materials are being collected with a view to its being built in the early part of next season. Beyond the Merrimack river, the grading, bridging, masonry, &c. of the road are contracted for, and in progress to the line of the State of New Hampshire, and the iron rails, sleepers, &c. for the superstructure, also ordered to be delivered in the spring.

At the line of the State, we are met by the Eastern railroad, in New Hampshire. This road has been located to the town of Portsmouth, and all the contracts made both for the road, bed, and superstructure, to be completed in time to be ready for public use before the close of the ensuing summer.

During the year, the number of passsengers transported over the whole or a part of the road, has been 298,813.

The treasurer's books and accounts have been examined, and as posted to the 31st December, it appears by them that the

Expenditures for the construction of the road for depot buildings, engines, cars, and all other expenditures of a permanent nature, up to that time, have been,		$1,306,196 89
And that the receipts have been as follows:		
From the sales of State scrip,		327,000
Leaving State scrip unsold,	$163,000	
From assessments,		879,436 07
		$1,206,436 07
The amount of net profits carried forward from the year 1838, as appears by our last report, is		$19,604 17

The books and accounts of the superintendent have been examined, and as posted to December 31st, it appears that the income arising from the business of the road, exclusive of the amounts reported last year, has been as follows:

Income from transportation of passengers, after deducting the amounts paid for ferriages at East Boston,	$113,068 63
From merchandise transportation,	7,375 67
From mail transportation,	1,310 50
From rents, interests, and other miscellaneous receipts,	3,868 35
	$125,623 15

And that the current expenses, arising from the business of the road, exclusive of the sums reported last year, have been as follows:

For repairs on the road,	$6,527 47
" of engines and cars, and work done in machine shop,	8,563 90
" fuel,	10,234 88

" wages of men, salaries and other expenses,		27,849 92
		$53,176 17

From the income of the road there has been paid,

Interest to the Commonwealth on loan,	$17,416 65
And dividends among the stockholders.	60,772 00

All which is respecfully submitted

Geo. Peabody, *Pres't.*, Robt. G. Shaw, Sam'l. S. Lewis, B. T. Reed, Pyam Lovett, Isaiah Breed, Stephen A. Chase, Jno. Hooper, Francis J. Oliver, Amos Binney, *Directors.*

FOURTH ANNUAL REPORT OF THE NASHUA AND LOWELL RAILROAD CORPORATION.

To the Honorable the Legislature of the Commonwealth of Massachusetts:

The Directors of the Nashua and Lowell railroad corporation, hereby submit their fourth annual report of their acts and doings, receipts and expenditures, under their act of incorporation.

The total amount of capital stock paid in, is	$299,000 00

Besides 500 shares, (or $50,000,) pledged to the Commonwealth.

The receipts from the opening of the road, to November 20, 1839, (a part of which is included in our last report,) have been as follows:

From passengers,		$36,646 92
" freight,		18,198 74
" rents,		207 92
		$55,053 58

The expenses paid during the same period, exclusive of the amount charged to cost of road, is

For repairs of road,	$3,948 94	
" repairs of engines and cars,	2,273 64	
" fuel, oil, salaries and expenses,	22,435 85	
		$28,658 43
Leaving the balance of profits,		$26,395 15
Add balance of interest account, &c., from commencement,		1,227 58
		$27,622 73

Out of which the following dividends have been declared:

May 29, 1839, 3 per cent. on 2,505 shares,	$7,515 00	
Nov. 27, 1839 4 per cent. on 2,990 shares, payable Feb. 1, 1840,	11,960 00	
		$19,475 00
Leaving a balance to be carried to the general depreciation and contingency account, of		$8,147 73

Since the last annual report, in which an account was rendered in detail of the cost of the road up to that time, there has been paid towards the completion of it as follows:

For land, damages, and fencing,	$23,940 24
" superstructure and rails,	18,608 58
" grading, bridging and sleepers,	1,647 79
" depots and fixturers,	11,646 29
" engineering and expenses,	2,273 76
" engines and cars,	16,606 04
	$73,722 70

Amount expended on cost of road, at the time of the last annual report,	$279,939 44
Making total cost of road to Nov. 20, 1839,	$353,662 14

The amount due from the corporation, Nov. 20th, on loan account, was as follows:

For money borrowed on pledge of State scrip,	$49,000 00
" cash received from other loans,	2,931 74
	$51,931 74

It will appear by our last annual report, that we commenced carrying passengers October 8, 1838, and freight on the 23d of November of the same year.

At the last session of your honorable body, application was made by our corporation, to fix the rate of toll to be paid by us, for the transportation of our freight over the Boston and Lowell railroad. By an agreement of parties, however, the subject was referred to three gentlemen to fix the rate until altered by the parties, or the Legislature. They awarded, that the Boston and Lowell railroad corporation, should furnish moving power, and taansport our freight cars, in connexion with their own, over their road to and from the junction of the Charlestown branch railroad, and that we should pay them therefore, the sum of ninety-six cents per ton, or four cents per mile. This agreement took effect June 1, 1839, and under it, we have paid to the Boston and Lowell railroad corporation, up to November 20, 1839, the sum of $5,073 27. By agreement of parties, this award was to operate back to March 1, 1839 and the Boston and Lowell railroad corporation were to repay to us a part of the excess over the rate awarded which had been paid by us to them for freighting; and under this agreement, we received the sum of $1,745 98.

A contract was made by us, March 20, 1839 with the Charlestown branch railroad corporation, by which they were to furnish moving power for th e transportation of our freight cars to and from the depot at Charlestown, over their road.

A contract of the same date, was also made with the Charlestown wharf company, by which said company were to erect for our accommodation, a freight depot in Charlestown, near the head of Warren bridge, furnish us with the use of certain wharves and lands, upon which rail tracks are laid so that freight can be easily taken directly from the vessel into the cars, thus effecting a great saving of expense. A copy of the contract with the said Charlestown branch railroad corporation is to be appended to this report. There was due under said contract, up to Jan. 1, 1840, the sum of $277 41. To the Charlestown wharf company, $613 03.

The whole length of the road, is $14\frac{1}{4}$ miles, $109\frac{3}{10}$ feet, of which 8 miles, $5036\frac{3}{10}$ feet lies in Massachusetts, and 5 miles 1673 feet in New Hampshire.

The number of planes in Massachusetts is 20, of which 7 are level.—The inclination of the others in feet per mile, is as follows; 1 of $4\frac{83}{100}$ ft.; 1 of 5 ft.; 1 of $9\frac{12}{100}$ ft.; 1 of $7\frac{45}{100}$ ft.; 1 of $6\frac{48}{100}$ ft.; 1 of $9\frac{78}{100}$ ft.; 1 of $5\frac{98}{100}$ ft.; 1 of $8\frac{44}{100}$ ft.; 1 of $7\frac{5}{100}$ ft.; 1 of $6\frac{88}{100}$ ft.; 1 of $9\frac{34}{100}$ ft.; 1 of 11 $\frac{37}{100}$ ft.; 1 of $13\frac{70}{100}$ ft.

The number of planes in New Hampshire is 9, of which 4 are level.—The inclination of the other 5, in feet per mile, is as follows; 1 of $11\frac{78}{100}$ ft.; 1 of $7\frac{19}{100}$ ft.; 1 of $5\frac{28}{100}$ ft.; 1 of $3\frac{49}{100}$ ft.; and 1 of $4\frac{29}{100}$ ft.

The changes from plane to plane, are made gradual by means of vertical curves.

The extent of inclined planes ascending from Lowell, is 36,850 $\frac{25}{100}$ ft.
The extent of descending planes from do. is 14,283 $\frac{60}{100}$ "

The track at the depot at Nashua, is 34 $\frac{24}{100}$ feet higher than the track at the junction with the Boston and Lowell railroad.

Curvature.—The radii of the curves in Massachusetts, vary in length from 1,050 to 10,000 feet. The greatest curve is at Lowell.

The radii of the curves in New Hampshire vary from 900 to 6,000 feet; the greatest curve being near the depot at Nashua.

Rails.—Edge rails of the T pattern are used, weighing about 57 lbs. per yard, supported by chestnut sleepers 7 feet long, and about 7 inches in diameter, at the mean distance of 3 feet apart from centre to centre. The sleepers rest on longitudinal sills of chestnut plank, about 3 inches by 8, with a short piece under the junction of these planks, and an additional one under the sleepers, which support the ends of the rails.

Grade.—The width of the embankments at top, is 15 feet; the width of the excavations at bottom, from 21 to 30 feet. And the bridge foundations, which are of stone, are generally of sufficient width for 2 tracks.

NASHUA, *November* 20, 1839—being the time to which the accounts were made up. Signed, *January*, 1840

Dan'l. Abbot, C. H. Atherton, Jesse Bowers, Joseph Greely, *Directors.*

FIRST ANNUAL REPORT OF THE NEW BEDFORD AND TAUNTON RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directors of the New Bedford and Taunton railroad corporation do hereby make their first report of their acts and doings, receipts and expenditures, under their act of incorporation, to the 7th of January, 1840 inclusive.

The first meeting of the stockholders was held on the 6th day of Feb. last, when the corporation was organized by the election of seven directors the act of incorporation was accepted, and by-laws adopted. At a meeting of the stockholders held on the 26th day of Oct. last, the act amending the charter, approved March 26th, 1839, was accepted.

The amount received for assesments on 2991 shares, is		$155,353 00	
Received for $50,000 scrip of the State, pledged for a loan,		48,000 00	
			$203,353 00
Paid for preliminary surveys,		3,673 37	
" engineering, including instruments,		7,874 42	
" land, damages and fencing,		37,613 05	
" graduation and masonry,	$60,470 68		
" clearing and grubing,	8,308 00		
" bridging,	3,000 00		
		71,778 68	
" lumber and preparing same,		16,587 81	
" transporting lumber,		1,000 00	
" on account railroad iron,		7,210 33	
" " cast iron chairs,		2,000 50	
" miscellaneous expenses,		3,301 76	
			$151,039 42

The work on the road commenced in May last, and we expect to get it completed so as to open it for use in the course of next summer.

All which is respectfully submitted.

P. G. Seabury, Joseph Grinnell, Thos. Mandell, Wm. W. Swain, Alfred Gibbs, David R. Greene.

FOURTH ANNUAL REPORT OF THE NORWICH AND WORCESTER RAILROAD COMPANY.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts, now in session:

The directors of the Norwich and Worcester railroad company, in presenting, in obedience to the laws of the State, their fourth annual report, deem it proper, in the present state of the road, and in view of the relations of the company to the State, to present somewhat at length a statement of facts in relation to the road.

The masonry, grading and bridges, of the entire railroad, from the freight depot at Norwich to the depot at Worcester are finished, and the superstructure is laid throughout the entire distance, with the exception of one mile on which the iron rails have not been laid, owing to the severe and repeated storms of snow which have prevailed during the winter.

The length of the railroad is 58 9-10 miles. The greatest inclination per mile is 20 feet, and for fifty two continuous miles, descending toward Norwich, the road is either level or descending the whole distance, there being no ascending grade.

The materials of the road bed are principally gravel. The masonry is throughout of the best materials and exceedingly durable and highly finished.

Although the company have encountered considerable expenses in order to avoid any grades exceeding 20 feet to the mile, and to obviate objectionable curves, the entire expense for masonry, grading and bridges including a tunnel through a solid rock has been but $9000 per mile.

In the superstructure, the company have sought to avail themselves of the experience of other railroads, and to render it in every respect permanent—the rail selected is of the heaviest kind, being 56 lbs. to the yard, and having also the unusual advantage of being in bars of 18 feet in length—although the adoption of so heavy a rail involved a very greatly increased expense—yet the advantages of superior safety, diminished annual repairs, and permanent economy, induced the company to encounter that expense, even in a time of very great pecuniary pressure.

There are eleven depots besides those at Norwich and Worcester, and the depot buildings, at most of these, are either built or in the course of construction. Although this is a large number, the accommodation of the manufacturing and other villages on the route would not allow the omission of any, and there are still other villages desirous of a similar accommodation, which the company are under the necessity of declining. The depots of Norwich and Worcester are very advantageously situated, and the directors have deemed it important at both places to secure, although at considerable expense, a sufficient quantity of land to transact the extensive business which they anticipate. The connexion with the Boston and Worcester railroad at Worcester is complete, and advantageous to both railroads—and it has been deemed expedient to erect the passenger house and engine house, for both railroads, at Worcester, to be used and occupied in common, by both railroads; and the arrangement is such, that the same cars for freight, and as far as is desirable, for passengers, pass without change or transhipment for the whole distance between Norwich and Boston.

At Norwich, the arrangements are in progress, and will be completed

early in the spring, by which passengers will be enabled to take the railroad cars at the steamboat wharf, and the baggage car will be transported from Boston to New York unopened, except at the two cities. The only power used is by locomotive steam engines—the great expense of horse power being entirely avoided.

The board have directed contracts to be made for furnishing nineteen eight-wheeled passenger cars, to be constructed by experienced builders, at Cambridge Port and Worcester, designed to accommodate very conveniently, forty-eight persons each, in addition to cars for second class passengers. They have also contracted with the same builders for a large number of freight cars.

The company have purchased four locomotive steam engines, and made contracts for four more, to be delivered on or before the middle of March next.

Arrangements have been entered into for the formation of a steamboat line, between New York and Norwich, in connection with the railroad, which will insure the placing on the line, suitable and convenient steamboats.

It is the design of the company, in connection with the Boston and Worcester railroad, to run a line of cars to and from the steamboat, stopping on either railroad only sufficiently often to supply the engines with wood and water, and to leave Norwich immediately on the arrival of the steamboat. In order to accommodate passengers desirous to stop at intermediate points, an accommodation train of cars will leave Norwich every morning at a fixed hour, and another train will leave Worcester in the afternoon, in advance of the steamboat train, which will receive passengers at all the depots.

In addition to the steamboat train and the accommodation train, both from Norwich and Worcester every morning and evening, it is the design of the company, provided a steamboat shall be placed on the route between Norwich and New Haven, as is now proposed by some individuals, to run an additional train of cars to and from Worcester, in such a manner as to form a daily line each way, by daylight, between Boston and New Haven.

If this arrangement should be perfected, there will be four passenger trains and one merchandise train, each way, over the road every day, except Sundays, on which day it is not expected that any train shall pass over the railroad.

By the steamboat train, the travel between Boston and New York, also to and from Worcester, and the country north, will be specially accommodated.

As to the amount of this business it is of course a matter of estimate; but as the route is exceedingly pleasant, expeditious, and every way desirable, and the charge for passengers will be moderate, there seems to be no reason why this route should not receive at least an equal share of the Boston and New York travel with any other route between these two cities. The distance over both railroads, from Boston via Worcester to Norwich, is 103½ miles, and thence by steamboat to New York, 130 miles; and the time required for the entire distance will not exceed, in favorable circumstances, fifteen hours.

In order to justify themselves to the stockholders of the company, and to the Commonwealth of Massachusetts, to whom the company are so much indebted for so extensive arrangements for business, the directors would present a few facts showing the extent of the business which will be accommodated by this railroad.

The road passes directly through and near a large number of manufacturing villages, there being within five miles of the road, 75 cotton mills and 27 woollen mills, exclusive of Norwich and Worcester.

The cotton mills in New London and Windham counties embrace more than three-fourths of all the cotton manufacture of the State, as shown by official returns.

In Worcester county there are 74 cotton mills, containing 124,000 spindles, manufacturing cotton goods of the value of $1,991,024—and 66 woollen mills, manufacturing 3,748,852 lbs. of wool into cloth, of the value of $3,695,321—452,310 pairs of boots, and 2,357,431 pairs of shoes, of the value of $2,791,298—147,240 hides, of the value of $387,038—129,710 axes, $119,825—chairs and cabinet furniture, $321,100—straw bonnets, $118,971—palm leaf hats, $411,554. Total value of aticles manufactured in Worcester county, more than $12,000,000.

The manufacturers in that county, of cotton, wool, hides, paper, iron castings, scythes, axes, cutlery, chairs and cabinet furniture, combs, ploughs tin ware and tanneries, number 456.

Amount of sperm oil consumed in woollen mills, 61,329 gallons.

The whole amount of manufactures in that county being, in one year, more than $12,000,000. The statistics, in detail, of the towns in Connecticut, cannot be accurately ascertained, but it is believed that a similar examination in New London and Windham counties, would show a similar result.

In the collection district of New London, which embraces the town of Norwich, there were, Dec. 31, 1838, three hundred and thirty-nine vessels, of 28,108$\frac{33}{95}$ tonnage, of the value of $1,250,000. The extent of intercourse between such a section of county and the cities of Boston and New York, fully justify the belief, that there will be a large amount of business in the transportation of passengers and goods to and from those cities — And the experience of all other avenues of travel and transport would indicate still larger returns from the border and local business.

The union with the Western railroad at Worcester, will be highly advantageous to both railroads.

This road will, in connection with the steamboats, furnish a cheap, expeditious, and desirable route to and from New York, for a large portion of the inhabitants of New Hampshire, and a part of Vermont.

In addition to its furnishing, in connection with the Boston and Worcester railroad and steamboats from Norwich, as desirable a route as any other between Boston and New York for passengers, it will it is supposed be entitled to receive a portion of the business connected with the transportation of goods between these two cities.

There will be no transhipment of the goods except at Norwich where it can be made with the greatest ease, and without truckage.

The navigation of the Thames and Long Island Sound, to New York, is unusually safe, so much so that the most prudent persons effect no insurance. And it is believed, that with perhaps one exception, there has been no loss of goods for thirty years, in the regular packets between Norwich and New York, which, if all insured, an insurance company would have been obliged to pay.

The charge for passengers between Norwich and Worcester, is fixed at $2—and the charge per ton for merchandise generally, from Norwich to Worcester, is $3.50, and from Worcester to Norwich, $3.

The charge for passengers between Boston and Norwich, is, by agreement of both corporations, fixed at $3—and the charge by steamboat, by

the existing arrangement, which it is supposed will continue to New York, is $2—making the passenger fare between Boston and New York, $5.

The charge for merchandise generally, over both railroads, from Boston to Norwich, will be $5 per ton.

It will be perceived that the foregoing rates of charge are unusually low and the directors have deemed for the interest of the stockholders, as well as for the public, that they should be so.

The accounts of the company have been duly examined by the commissioners appointed under the charters.

By the books of the treasurer, it appears that the amount of funds received into the treasury of the company, from all sources, to the 31st December, 1839, is $1,360,600, and the expenditures to the same time, to the sum of $1,360,527 27. A statement showing the amount of the expenditures under the different heads, is contained in the report of the commissioners, which is appended to this report, and constitutes a part of it.

By the foregoing statements, it is hoped it will be apparent that the public, as well as the stockholders of the company, well be benefited by the opening of this railroad. If the success should attend it which is now promised and expected, the directors will feel themselves fully repaid for a large amount of gratuitous labor in the service of the company.

No motive has operated more strongly upon the minds of the directors, amid the most serious discouragements and obstacles, than to fulfil, in behalf of the company, the engagements which were made to the Commonwealth of Massachusetts, when her Legislature furnished the timely and essential aid of her credit for the sum of $400,000. These engagements we now believe are fulfiled. The road is substantially finished, in many respects in a better manner, in no respect inferior, to what was then promised, and for comparatively a very moderate cost.

It is the design of the company, at the same time that they do what is necessary for the preservation of the road, and the advantageous and convenient use of it, to practise the utmost frugality in relation to the expenses of the company.

All which is respectfully submitted.

John A. Rockwell, John Breed, Russell Hubbard, Ralph Bolles, Jedediah Huntington, Thos. Robinson, *Directors.*

FIFTH ANNUAL REPORT OF THE TAUNTON BRANCH RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

The directors of the Taunton branch railroad corporation, do hereby make the fifth annual report of their acts and doings, receipts and expenditures.

On November 1, 1839, a contract was entered into between this corporation and the New Bedford and Taunton railroad corporation, a copy of which is hereto annexed, and made part of this report.

The total amount of capital paid in, is	$250,000 00

The Expenditures during the year ending November 30, 1839, have been as follows:

Amount of repairs on the railroad,	$1,397 14
Expenses incurred in improving the railroad and the depot at Taunton,	4,164 83
Amount of repairs on the engines and cars,	3,151 99
Miscellaneous expenses, including the amount paid to the Boston and Providence railroad corporation for their pro-	

portion of the receipts,	30,630 69
Expenses incurred in the construction of the road,	1,367 13
Total amount of expenditures,	$40,711 78

The receipts during the year ending November 30, 1839, have been as follows:

Amount received for the transportation of passengers,	$40,910 73
" " " " merchandise,	15,895 10
Amount of other miscellaneous receipts,	1,212 95
Total amount of receipts,	$58,018 78

Two dividends of three per cent. each have been made, payable on July 1, 1839, and January 1, 1840, respectively, amounting in the aggregate to the sum of $15,000 00

All which is respectfully submitted,

Thomas B. Wales, Samuel Frothingham, Samuel Quincy, William A. Crocker, *Directors.*

FOURTH ANNUAL REPORT OF THE WESTERN RAILROAD CORPORATION.

To the Honorable Legislature of the Commonwealth of Massachusetts:

On the 1st day of January, 1839, under which date our third annual report was submitted, the grading of the road, eastward of Connecticut river, was nearly completed—the bridges were in construction,—the iron and timber for the superstructure were purchased,—six miles of the track were laid down,—the engines and cars were under contract,—the depot lands were secured,—and the damages for land and fencing were liquidated and principally paid. The directors at that time expressed an opinion, that the road-bed would be ready for the rails by May succeeding, and that if no unforseen obstacle interposed, the whole of this part of the line would be in successful operation by the first of October last.

This anticipation was realized. The grading, masonry, bridging, superstructure and depot buildings were sufficiently completed, the engines and cars were delivered, and the road opened for the conveyance of passengers, on the first day of October, and it has continued in operation to the present time.

Regular merchandise trains were established on the 23d October, and they have been continued to this date.

Throughout the greater part of the road, it is graded for a single track only; and but one track has been laid down, with the exception of the necessary turn-outs at the nine stations. The engineers, at an early period, recommended the grading of the entire line for a double track. But under the uncertainty then existing, of procuring funds for the completion of the whole road, the directors, upon full consideration, deemed it prudent to order the grading generally for one track; at the same time giving the engineers "discretionary power, as to the cuts, embankments, and bridges, to make them of such width and construction, as should best subserve the interests of the corporation and the public, taking into account the contingency of a double track hereafter."

Under this authority, the deep cuts, the heavy embankments, and the masonry and bridges have been constructed of the full width for a double track.

The exact length of the line, from the junction with the Boston and Worcester road, to the east bank of the Connecticut river, is fifty-four miles

184 rods. The intermediate distances are given in a table hereto annexed.

In the construction of this part of the road, the directors have endeavored to make a permanent and substantial structure. Great pains have been taken to remove from the road-bed, all materials which would be seriously affected by frost, and to supply their place with gravel or sand. The superstructure is of the most substantial character; and the masonry will not suffer in comparison with that of any other road in the country. In the erection of depot buildings, and the construction of cars and engines, the board have consulted usefulness, convenience and durability, with little regard to ornament or show. And with the short experience which they have had, the undersigned are satisfied, that these objects have all been accomplished; and they are happy to congratulate the stockholders and the community upon the successful result of their labors thus far.

Although the road was sufficiently completed to be open for use on the 1st day of October last, many parts of it were so unfinished as to require some force to be kept upon the *construction* nearly to the present time; and it is not now found practicable to state the exact cost of this portion of the line. This will be presented in a future report, together with such other information as is required by law.

The accounts for these expenditures are, however, principally liquidated and paid. And it is believed, that an estimate, generally correct, may now be made, of such claims as are yet out-standing. Upon this basis, the following will be found to be a nearly correct statement of the cost of the road east of the river. But it must be borne in mind, that these items may be varied when the final statement is given.

Graduation, masonry, bridging and superstructure, for main track,	54 m. 3036 ft.	
Turn-out and depot, do.	2 1310 ft.	
	or 56 ms.	$1,633,122 60
Engineer department, surveys, instruments, etc., for four years,		64,618 93
8 engines, 5 long passenger cars, 10 short do., 2 forward do., 3 baggage do., 50 merchandise do. 40 gravel do. and 3 hand do.,		100,004 83
Depot buildings for nine stations, furniture, aqueducts wells, machine shop, &c.,		54.412 18
Land damages and fencing,		89,037 47
Depot lands at 9 stations, about 18 acres,		6,038 43
Miscellaneous expenses, including salaries, printing, stationary, office rents and expenses, clerk hire, collecting assessments, postages, &c.,		25,251 53
Total east of river,		$1,972,985 97
Being about $36,135 per mile.		
The estimate for this part of the road, made in December, 1838, was		$1,864,729 12
Surplus cost above estimates,		108,256 85

This excess above the estimates, being a little less than six per cent., is not caused by the extra cost of the items *actually estimated*; for, except in one or two cases of small amount, these in fact, have not cost more than was anticipated. But the principal difference arises, in the *first* place, from

the fact, that at the time the estimates were made, the work of graduation was in progress, and the cuts were in a rough state, and could not be measured with any great degree of accuracy. The quantities returned as excavated, were deduced in most cases, from the previous monthly estimates, and the estimates were put upon it according to those results. Since it has been completed, it has all been re-measured for the final settlements, and it is now ascertained that the quantity of materials excavated, much exceeds that actually estimated.

In the *next* place, as the work has advanced, it has been found necessary and economical, in order to accommodate the business of the road, to procure larger quantities of many articles for its equipment than were supposed necessary; to increase the number and size of the buildings at the depots, to add to them expensive aqueducts and fixtures, and to enlarge some of the bridges. The length of the track, including turnout and depot tracks proves also to be about eight-tenths of a mile more than was estimated for —the wheels and springs of the cars are more substantial and expensive than was originally intended and in one or two cases, the cost of grading a section has been necessarily enhanced in consequence of the failure of the contractor, and his inability to finish his work.

The following is a statement of the principal items of cost not estimated, viz:—

Excess of excavation above estimates—addition to bridges —increased length of track, and improved switches, and extra cost of finishing a small part of the grading,	$80,766 13
Additional number of cars, and improved wheels for the whole,	12,946 67
Increased number and size of buildings, and addition of aqueducts and fixtures,	11,500 00
Additional quantity of land purchased for the depots since the estimates,	2,638 43
Total,	$107,851 23

And in view of these expenditures, it should, be borne in mind, that the depot arrangements at Springfield are designed, and are on a sufficiently extensive scale, to afford the necessary accommodation for the business of the road west of the river. The same remark applies to the machine shop tools and fixtures, and in part also to the engines and cars already provided.

The whole of the expensive depot arrangements at Springfield, will be as necessary to the western as to the eastern portion of the road and, the cost of them ought in fact to be apportioned upon both sections of the line equally.

At the date of the last report to the Legislature, the whole line of the road *westward of Connecticut river*, a distance of 62·6 miles, had been definitely located, with the exception of a few miles in Westfield and the south part of Russel—about 34½ miles of the western part of it had been under contract for grading from March, 1838, and excepting ten miles immediately east of Pittsfield, the work had been commenced in June and July succeeding, and was then in successful progress.

In March, 1839, the board, after a full and personal examination by a committee, directed the definite location of the road through Westfield and the south part of Russell, to be made entirely upon the northerly side of the Westfield great river, and as near the village of Westfield as was practicable without two crossings of the river.

Early in the last season, the grading was commenced upon the 10 miles

east of Pittsfield, and upon this, as well as upon the residue of the 34½ miles between Henry's and the State line, the work has been vigorously prosecuted to the present time.

The 28 miles between Connecticut River and Henry's in Chester, were put under contract for grading in April last, and as soon as was practicable after the passage of the act of the last Legislature; the contractors engaging to complete the grading and masonry by the first of July, 1840.

Upon the greater portion of this part of the line, the work was commenced in July succeeding, and the whole is now in progress. It is confidently believed, that the graduation and masonry will be finished in season for laying down the rails in the course of the present year.

Preparations are also making for materials for the bridge across the Connecticut at Springfield; the lumber having already been contracted for. And the directors hope to finish the same, and to lay down the track for at least 20 miles westward of it, and open the same for use during the year.

The graduation west of Pittsfield is nearly completed, with the exception of two sections. The cuts upon each of these proved to be much more difficult than was anticipated. The contractors have been always impeded by water, and in the winter months, by the constant freezing and thawing of the materials. On one of these sections the principal work, was entirely suspended during last winter from this cause. Upon another, the embankment has for a long distance settled from 40 to 45 feet below the natural surface of the meadow. And upon these, as well as some others in the vicinity the work has been entirely interrupted by the recent snows;—the contractors having been obliged to employ their whole forces, in some instances, for two or three weeks in removing the same.

This part of the road, however, being 11½ miles, will be graded, the superstructure put upon it, and the whole opened to the public in the autumn of 1840.

The undersigned anticipate, also, that a further portion of 10 miles of the road, east of Pittsfield, and extending eastward to the summit division, will be graded by the 1st of August next, with the exception of two sections in Hinsdale and Dalton. The contracts for these require them to be completed by the 1st of October, and they are already in a good state of forwardness.

The remaining *Summit Division* of about 13 miles, extends from Henry's in Chester, through the *gorge* of the mountain, and over the summit in Washington, to the Hinsdale Meadows, embracing the whole range of the mountain pass. This is by far the most difficult and expensive work upon the whole line. And such have been the obstacles interposed by nature to our progress, that it may not be amiss to advert, briefly, to the extent and character of this part of the work.

The west branch of the Westfield river, or the Pontoosuc, as it is now called, winds its way from the summit, by a rapid descent, down a narrow defile of the mountains, pursuing a very circuitous route,—frequently turning the point of an abrupt rocky spur, only to be again thrown out of its course, by a similar spur upon the opposite bank, which, in turn, it is obliged to double by curving suddenly in another direction. The road follows up the general course of this stream to the summit. And in order to avoid excessive curvature, and to maintain uniform grades by a continuous ascent, the line of it necessarily crosses these spurs, successively. It passes them by heavy rock excavations, spanning the stream, often obliquely, and in some cases, at a height of 60 and 70 feet above the water, and with very heavy and expensive masonry.

Within the 13 miles, the river is passed by 21 bridges, 9 of which are stone arches, and 3 of these are of 60, and 5 of them of 45 feet span; and they sustain embankments, severally, of 40, 37, 52, 62, 70, 60, 42 and 31 feet above the water. Many of these require also heavy bank or river walls, some of which are 60 and 70 feet in height. The embankments must, of course, in many instances, await the completion of the bridges and walls. The masonry has been pushed vigorously, and as much of it is in progress as can well be carried on at one time. On the 1st of December last, 15,300 perches of it, (of 25 feet,) were finished, and 37,500 were yet to be built; 25,000 of which, however, are bank walls; of earth 136,000 cubic yards, and 86,000 of rock, had been excavated, and 304,000 yards of earth, and 97,000 of rock, remained to be taken out.

The *Summit ridge* is passed by a thorough cut above 2,600 feet long, and its deepest point 52½ feet. About 57,000 cubic yards of this is estimated to be rock, and much of it is of the hardest kind. The whole material of the cut should come out in one direction, in order to form the large embankment east of it; and while the rock continues, but comparatively a small force can be employed upon it.

The grade immediately east of the summit is at the rate of 77.6 feet per mile; and still farther east it is 79·9 feet for two miles. At the summit, the road bed is 1378 feet above the Springfield depot, and about 1440 feet above tide water at Boston.

From present appearances, these summit sections will be the last work finished upon the line. In our report of last year it was stated, that in the condition in which it then was, no definite opinion could be formed, as to the time when it would be completed, and that this point could not reasonably be ascertained, before late in the year 1839, when the character of this rock cutting might be more clearly developed. The work is now so far advanced, as to justify an opinion, that the grading and masonry of this *whole division* may be finished in season for laying down the superstructure during the year 1841.

The parts of the road west of the river, already graded at different intervals, are as follows:

Between Springfield and Henry's in Chester,	5th Div.	4·5 miles
do. do. do. do.	6th "	4·8 "
On the summit division, or	7th "	8·4 "
On the 8th division, east of Pittsfield,		5·72 "
do. do. west of do. to State line,		9·68 "
Total, graded Dec. 1, 1839,		33·1 "
Leaving to be graded about		29·5 "

From this view, it will be seen, that of the 62·6 miles of the road west of Connecticut river, if no unexpected obstacle interposes, about 50 miles may be graded and ready for the superstructure during the present year, viz., 21½ miles at the westerly end, 28½ miles at the easterly end, that by the same time the superstructure may be placed upon at least 11½ miles of the westerly part, and 20 or more miles of the easterly part, and the same be opened for use, that in the spring of 1841, the rails may be laid upon all the residue, excepting some 10 miles of the summit division; which may be completed in all that year.

Of the *Iron* for the superstructure, 3,500 tons have been purchased;—about 2,000 tons of it have arrived, and the ballance for the whole line having been ordered to be purchased, will be forthcoming, as the work may require it.

(To be continued.)